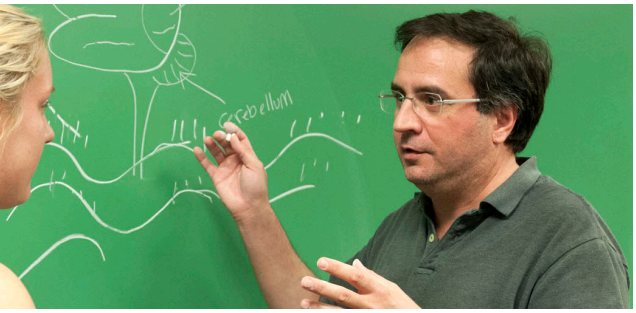
INNOVATE
EVIDENCE-BASED MENTAL HEALTH RESEARCH



Stimulating Cognition

Cognitive impairment is common with mental illness and results in a decreased ability to pay attention, remember information, think critically and solve problems. Transcranial direct current stimulation (tDCS) is increasingly being used to enhance cognition and improve symptoms often associated with mental illness. However, understanding exactly how stimulation changes the brain functionally and structurally still is not fully understood.

Evan Antzoulatos, Ph.D., a UC Davis Behavioral Health Center of Excellence 23 Pilot Grant award recipient, is investigating the effects of tDCS on the brain through the study, "A Translational Approach to Development of Electrical Brain Stimulation for Cognitive Enhancement", in collaboration with UC Davis professors Charan Ranganath and Martin Usrey.

Help for All

Ultimately, this project aims to contribute a non-pharmacological, non-invasive treatment to patients with schizophrenia or other mental illnesses. "With this research we are going to see how to boost cognition in healthy individuals, treat cognitive problems in patients with neuropsychiatric conditions, and protect executive functions in the aging population," said Antzoulatos.

By determining the optimal pattern of stimulation with tDCS, clinical researchers will be armed with preliminary data to successfully develop safe and effective treatment programs for neuropsychiatric disorders.

Optimal Patterns

Antzoulatos is interested in two parts of the brain and their interactions— the newest area to evolve, the prefrontal cortex, and one of the oldest, the basal ganglia. The prefrontal cortex, the area right behind the forehead, is responsible for executive functioning such as attention, working memory, categorization, decision-making, and inhibition. The basal ganglia are also involved in these functions, but have primarily been associated with motor functions due to their malfunction in motor diseases such as Huntington's and Parkinson's disease.

The prefrontal cortex and the basal ganglia interact through a closed feedback loop and reciprocally stimulate one another. This loop is the frontostriatal network, which has been shown to be important in learning.[1] Antzoulatos will use electrodes to monitor brain activity

"The Behavioral Health Center of Excellence at UC Davis brings together many different experts at many different levels of analysis, from cellular and molecular neuroscientists all the way to psychiatrists treating patients. This environment fosters collaboration. We are at an age now where single experts in one field do not find solutions. The Center is needed to bring people together to share ideas."

- Evan Antzoulatos, Ph.D., Assistant Project Scientist, Center for Neuroscience, College of Biological Sciences

in the striatum after applying tDCS to areas of the brain.

Transcranial direct current stimulation is a non-invasive way to stimulate the brain. It works by applying a low current, about the strength of a 9-volt battery, via electrodes directly to the scalp. It can be anodal (positive) or cathodal (negative) to either excite or inhibit neurons in the brain.

tDCS is used as a research tool to understand the functions of the brain, in clinical applications, and for recreational use. Because it is easily accessible, portable and painless it has gained popularity in the gaming industry as a way to gain a competitive advantage. Even though tDCS use has increased dramatically recently, we still do not know exactly how it works in the brain. Antzoulatos will study the long-term consequences and how the brain changes when you stimulate it. He will use MRI structural images of the brain to inform the placement of electrodes that will monitor brain activity.

In addition, biomarkers have been identified using EEG, a test that detects brain activity through sensors attached to the scalp, to distinguish responses that differentiate a diseased brain from a healthy brain. In this project, EEG technology will be used while recording activity in the brain to see how stimulation changes activity and conversely, how those changes affect the EEG biomarkers.

Antzoulatos and Stacey Seidl, the graduate student on this project, will see how stimulation changes the activity in the brain and its interactions with other structures. The goal for this project is to find out what happens in the brain when you use tDCS, what happens when you use different patterns of tDCS, and finally to identify the optimal patterns of stimulation with tDCS.

Dr. Antzoulatos recently joined the faculty at UC Davis from Earl Miller's lab at MIT where he worked primarily on basic animal research and categorical learning. "This grant allows me to transition to more translational applied research that will have more direct applicability to help patients with neuropsychiatric conditions," stated Anzoulatos.

1. Chudasama, Y.; Robbins, T.W. (July 2006). "Functions of frontostriatal systems in cognition: Comparative neuropsychopharmacological studies in rats, monkeys and humans". Biological Psychology 73 (1): 19–38. doi:10.1016/j.biopsycho.2006.01.005

Behavioral Health Center of Excellence at UC Davis

UC Davis launched the Behavioral Health Center of Excellence in October 2014 to advance mental health research and policy with initial funding from the Mental Health Services Act. The Innovate series highlights the Center's $4.3 million Research Pilot Award program.

www.behavioralhealth.ucdavis.edu
@UCDbrainhealth

UCDAVIS
BEHAVIORAL HEALTH CENTER OF EXCELLENCE